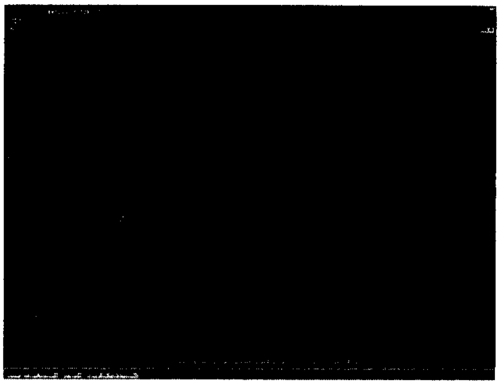
cardially on a GE/VingMed Vivid FiVe® scanner. Hemodynamic conditions were altered by administration of blood, dobutamine and metoprolol for a total of 29 steady hemodynamic states. Myocardial longitudinal peak SR during systole was measured off-line in the basal, mid and aneurysmal segments. **Results:** Peak systolic SRs in the basal segments (longitudinal shortening) were negative as expected (baseline -1.06 ± 0.31, range of all stages -0.44 to -3.92). These were significantly different from the aneurysm segment results which were either near zero or positive (baseline 0.11 ± 0.11, range of all stages -0.03 to 1.6, p<0.001). Administration of blood and dobutamine tended to increase and metoprolol decrease the negative (contraction) SR values in the basal segments but not in the aneurysmal segments. There was separability by SR between the basal and akinetic aneurysm segments at all stages, defining an area with close correlation (r=0.93) to the size of the aneurysm measured post-mortem.



9:48 a.m.

1165MP-125 Strain Rate Imaging or Doppler Myocardial Imaging for the Detection of Regional Myocardial Ischemia During Stress Echocardiography: Which Method Is Superior?

Jens-Uwe Voigt, Bert Exner, Kristin Schmiedehausen, Andrej Schmidt, Dierk Werner, Uwe Nixdorff, Frank A. Flachskampf, Werner G. Daniel, *University Erlangen, Erlangen, Germany.*

Background: In the past, many attempts have been made to use Doppler myocardial imaging (DMI) to make the interpretation of stress echo studies less subjective. However, high interindividual differences in wall motion velocities as well as translation artefacts and particular velocity summation effects complicate the reading of such data. Strain Rate Imaging (SRI) is a new tissue Doppler based technique to identify literally regional myocardial dysfunction independent of translation and summation artefacts and therefore may be superior to DMI.

Methods: 13 patients with suspected coronary artery disease but normal regional myocardial function at rest underwent a standard dobutamine stress echo (DSE) examination. Tc-Sestamibi (MIBI) was administered simultaneously at peak stress for the comparison with scintigraphy. Myocardial colour Doppler and grey scale loops were acquired from an apical window with a System Five scanner (GE Vingmed, Norway). Curved M-Mode (CMM) still images of longitudinal velocity (VEL) and strain rate (SR) of 2 or 3 heart cycles were reconstructed from the digitally stored data for each left ventricular wall. According to literature, a delayed or reduced systolic deformation (SRI) or delayed or reduced peak systolic VEL (TVI), and the occurrence of post systolic shortening (PSS, SRI) or prominent positive post systolic VEL peaks (TVI) were chosen as markers of ischeamia. Readings were compared segmentwise to MIBI.

Results: A total of 234 myocardial segments (SEG) was analysed. According to MIBI, 35 SEG became ischaemic at peak stress. In SRI CMM still images, those SEG were recognised with a sensitivity (SEN) of 78% and a specificity (SPEC) of 95%, which was not significantly different from conventional grey-scale quad screen readings. For TVI CMM, however, the segmentwise comparison to MIBI showed a SEN of 44% and a SPEC of 90% (p<0.01).

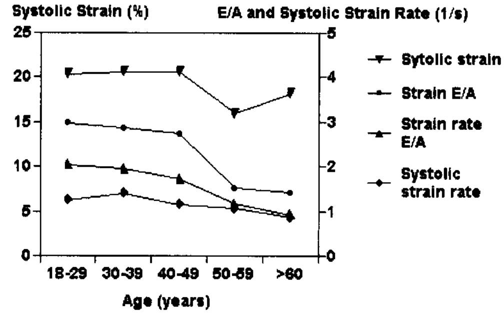
Conclusion: Besides some VEL pattern changes in basal segments, TVI was not able to reliably detect stress induced ischeamia during DSE in this study. SRI, however, allowed to more accurately describe myocardial ischaemia. We conclude, that SRI may have the potential to objectify stress echocardiography.

10:00 a.m.

1165MP-126 Regional Myocardial Strain and Strain Rate Measurements by Tissue Doppler Echocardiography in 100 Normal Volunteers

Jing Ping Sun, Neil L. Greenberg, Graig R. Asher, Mario J. Garcia, William J. Stewart, James D. Thomas, *The Cleveland Clinic Foundation, Cleveland, Ohio.*

Background: Evaluation of regional myocardial function is an important goal in clinical cardiology. A new echocardiographic method of quantifying regional deformation has been introduced based on the principles of 'strain' and 'strain rate' imaging. This method has been validated in animal experiments and early clinical use. However, there are limited measurements in normal populations to use as data reference. **Methods:** In 100 (52 male, 42±15 years old) normal volunteers, strain and strain rate were measured by tissue Doppler image (GE-Vingmed Vivid Five, Milwaukee, WI) on apical 4 and 2 chamber views. Each wall of the LV was divided into base, middle and apex and all measurements were averaged from three cardiac cycles. The study population was divided by age group (18-29 years, 22 persons; 30-39,22; 40-49,22; 50-59, 18; ≥ 60, 16). **Results:** Systolic strain and strain rate tended to decrease after age 50 years (p=0.08 and 0.03 respectively), with a more significant fall in diastolic E/A ratio of strain and strain rate after age 50 year (p≤ 0.003). Ventricular septal wall data are shown in the figure.



Conclusion: Myocardial strain and strain rate may present a new, noninvasive method for quantifying regional myocardial function. Like Doppler mitral inflow velocity, strain and strain rate show age-related changes. These normal values should assist in bringing strain and strain rate imaging into more widespread clinical use.

10:12 a.m.

1165MP-127 Angle-Corrected Color Strain Imaging and Its Application to Quantitative Assessment of Regional Contraction

Satoshi Nakatani, Jiyoong Kim, Akihisa Hanatani, Yoshio Yasumura, Masakazu Yamagishi, Masafumi Kitakaze, Kunio Miyatake, *National Cardiovascular Center, Suita, Japan.*

Background: Myocardial strain rate, defined as the spatial differentiation of local velocity, is determined by tissue Doppler imaging. Although strain rate can reflect regional wall function independent of heart translation, it is susceptible to noise and only motion parallel to the ultrasound beam can be determined. Integration of strain rate by time yields myocardial strain that is more robust to noise. Therefore, it is expected that application of strain and calculation of the velocity component toward a contraction center can solve the above problems. We thus developed prototype 2-dimensional angle-corrected tissue strain imaging system capable of displaying color-coded strain (ApliQ, Toshiba Corp., Japan) and quantitatively assessed wall motion by myocardial strain.

Methods: 16 patients with various cardiac diseases (14 men, mean age 49±14 years) were studied using tissue Doppler imaging. Parasternal long-axis view was obtained and septal 2 segments and posterior 2 segments were analyzed. To correct the Doppler incident angle, a contraction center was set at the apical 1/3 in the left ventricular cavity. Then, tissue velocity and myocardial strain rate toward the center were calculated. Angle-corrected myocardial strain was obtained by integrating strain rate using 2-dimensional tissue Doppler tracking technique, and color-coded strain imaging was displayed (red = lengthening, blue = shortening).

Results: Angle-corrected color strain imaging could show strain map on 2-dimensional image, which well reflected wall motion. 62 segments were quantitatively analyzable (28 = normokinesis, 19 = hypokinesis, 15 = akinesis). Myocardial strain of normokinetic, hypokinetic and akinetic segments were significantly different each other (118±46% for normokinesis, 38±27% for hypokinesis, p<0.0001 vs. normokinesis, and -3±15% for akinesis, p<0.0001 vs. normokinesis and p<0.005 vs. hypokinesis).

Conclusion: The newly developed angle-corrected myocardial strain imaging could show the color map of regional strain. Myocardial strain determined by the present system was useful to assess wall function quantitatively.

10:24 a.m.

1165MP-128 Should Both Regional Deformation and Velocity of Deformation Be Measured to Characterize Changes in Myocardial Deformation Induced by Alterations in Inotropic States and Heart Rate?

Frank Weidemann, Fadi Jamal, Piet Claus, Miroslaw Kowalski, Liv Hatle, Ivan De Scheerder, Frank Rademakers, Bart Bijnens, George R. Sutherland, *University Hospital Gasthuisberg - Cardiology Department, Leuven, Belgium.*

Background: We sought to investigate in a closed-chest pig model how the two regional deformation parameters peak systolic strain rate (maximal velocity of deformation in systole) and systolic strain (magnitude of deformation in systole) are related to stroke volume and contractility in the presence of a wide range of heart rates (HR) and positive or negative sympathetic pharmacological stimulation.

Methods: In 20 closed chest pigs regional radial deformation of the posterior wall was quantified by ultrasound derived peak systolic strain rate and systolic strain measurements. A Contractility index was measured as the ratio of end-systolic strain / end-systolic wall-stress. HR and contractility were varied by atrial pacing (AP=100-80/min, n=7), incremental dobutamine infusion (DI=2.5-20 mg/kg/min, n=7) or continuous esmolol infusion (0.5 mg/kg/min) + subsequent pacing (100-180/min) (EI group, n=6).

Results: Baseline peak systolic strain rate and systolic strain averaged 5.0±0.4 1/s and 60±4 %. Peak systolic strain rate and the contractility index increased linearly with DI (20 µg/kg/min: strain rate=9.9±0.7 1/s, p<0.0001 vs baseline) and decreased with EI (strain rate=3.4±0.1 1/s, p<0.01). During pacing, peak systolic strain rate and the contractility